RECENT numbers of the *Communications* from the Physical Laboratory of the University of Leyden are occupied with work carried out in the cryogenic laboratory, which has been reopened after completing certain safety arrangements required by the Privy Council. Dr. H. Kamerlingh Onnes gives an account of certain methods and apparatus, including (1) a cryostat or boiling-glass and boiling case, for measurements with liquefied gases, especially oxygen; (2) the arrangement of a Brotherhood air compressor for the compression of gases to be kept free from admixture with air; (3) methods of pouring out little quantities of liquid nitrous oxide; and (4) boiling nitrous oxide in large quantities. In another issue, Dr. E. van Everdingen, jun., describes a continuation of his experiments on the Hall effect at the low temperatures now available, and has found no indication of a maximum value to this effect down to the boiling point of liquid oxygen. Dr. Fritz Hasenoehrl investigates the dielectric constants of liquid nitrous oxide and nitrogen, a branch of investigation previously carried out by Dewar and Fleming. The results are for nitrous oxide 1·933, and for oxygen 1·465, as compared with Dewar's 1·491, while the Clausius Menotti formula is at any rate not negatived by the experiments.

MESSRS. WATKINS AND DONCASTER have sent us their catalogue of natural history apparatus, books, birds, eggs, lepidoptera and other requisites of the field naturalist.

A SECOND edition of Part ii. of Prof. Chrystal's "Algebra" has just been published by Messrs. A. and C. Black. The principal changes occur in the sections on the Theory of Series, which have been rendered more useful to students proceeding to study the Theory of Functions. In the interests of the same class of readers, a sketch of the modern theory of irrational quantity has been added to the chapter. The first edition of Part ii. of Prof. Chrystal's work has already been noticed in NATURE (vol. xli. p. 338), and the merits of the work are so well known that it is unnecessary to do more now than announce the publication of the new edition.

THE London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., offers exceptional opportunities of obtaining observational knowledge of the physical geography and geology of the London district. Visits are made to selected places on Saturday afternoons between the end of April and the beginning of July, and short addresses are given upon the characteristics of the rock structures and the development of the land forms seen during the excursions. The places to be visited this year have been selected with the view to illustrate the geological structure of the London basin by an examination of Cretaceous rocks at Godalming, Oxted, Gomshall and elsewhere, and of the Oolite of Bedford. The first excursion will be made on April 28.

SEVERAL parts of elaborate scientific memoirs in course of publication by Mr. W. Engelmann, of Leipzig, have been received from Messrs. Williams and Norgate. Included among these recent works are:—"Monsunia: Beiträge zur Kenntniss der Vegetation des süd- und ostasiatischen Monsungebietes" (Band i.), by O. Warburg; "Monographieen afrikanischer Pflanzen-Familien und Gattungen: IV. Combretaceæ excl. Combretum," by A. Engler and L. Diels; "Genera Siphonogamarum ad Systema Englerianum Conscripta" (Fasciculus i.), by Drs. C. G. de Dalla Torre and H. Harms; and "Conspectus florae graecae" (Fasciculus i.), by E. de Halacsy. In addition to these publications of the house of Engelmann, we have received from the firm of Gebrüder Borntraeger, Berlin, the first part of the first volume of "Die mikroskopische Analyse der Drogenpulver," an atlas for chemists and druggists, by Dr. Ludwig Koch. We propose to review these works when they have been completed.

THE question as to the origin of the energy possessed by the Becquerel rays is one of considerable interest. The existence of substances capable of emitting radiations possessing energy, without any appreciable loss of weight or introduction of work from external sources, would appear to be impossible from the view of conservation of energy. The measurements of M. Henri Becquerel upon the deviation of the radium rays in an electric field, taken in conjunction with those of M. and Mme. Curie of the charges carried by these rays, lead to results which show a way out of this difficulty, on account of the extreme minuteness of the quantities of energy in question. The calculations of M. Becquerel show that the energy radiated per square centimetre is of the order of one ten-millionth of a watt per second. Hence a loss of weight of about a milligram in a thousand million years would suffice to account for the observed effects, assuming the energy of the radium to be derived from an actual loss of material.

THE detailed study of the hydrocarbon indene has hitherto been hindered by the difficulty of obtaining it in large quantities in a pure state. In the March number of the *Journal* of the Chemical Society, Messrs. Kipping and Hall describe two new syntheses of indene, in which the yields are practically theoretical. Cinnamic acid is the starting point, from which α-hydrindone is prepared by methods previously described; the oxime from this is then reduced to α-hydrindamine, from which indene can be obtained either by heating the hydrochloride at 250° C., or by preparing the iodide of trimethyl-hydrindamine and submitting this to dry distillation. The indene thus prepared was shown to be identical with that synthesised by Perkin and Révay, and also with indene from coal-tar.

IT is now very generally agreed that the true constitution of the sulphites is represented by the unsymmetrical formula $R.SO_2.OR$, as opposed to the symmetrical $SO.(OR)_2$. One interesting outcome of the former view is that there should be isomeric double sulphites, the one $R.SO_2.OR'$, and the other $R'.SO_2.OR$, and Schwicker and Barth have indicated the existence of such isomers in the case of sodium potassium sulphite. Dr. Fraps, however, in the March number of the *American Chemical Journal*, after carefully repeating these experiments, has been driven to the conclusion that no such isomerism exists in this case. This coincides with the views of Hantzsch, who holds that structural isomerism is unknown in inorganic bodies.

THE additions to the Zoological Society's Gardens during the past week include a Secretary Vulture (*Serpentarius reptilivorus*) from South Africa, presented by Mr. James D. Logan, jun.; a Spanish Blue Magpie (*Cyanopolius cooki*) from Spain, presented by Mr. E. G. B. Meade-Waldo; a Greater Black-backed Gull (*Larus marinus*), European, presented by Mr. H. Clinton Baker; four Marbled Newts (*Molge marmorata*) from Bordeaux, presented by Mr. G. A. Boulenger, F.R.S.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE IN ANDROMEDA.—Dr. T. D. Anderson, of Edinburgh, has communicated to the *Astronomische Nachrichten* (Bd. 152, No. 3632) his observations of the variability of a new variable star in the constellation of Andromeda. The co-ordinates of the star's position are:—

$$\left.\begin{array}{ll}\text{R.A.} & = \quad 0\text{h.} \quad 8\cdot5\text{m} \\ \text{Decl.} & = +46^\circ \quad 12'\end{array}\right\}(1855.)$$

lying almost exactly on the boundary between Cassiopeia and Andromeda. It is not mentioned in the Bonn *Durchmusterung*, As measured from the comparison stars B.D. +46°·38 (8·5), 40

(9·6) and 48 (9·1), the following are the observed magnitudes of the variable:—

1900. Jan.	16	...	8·8
	19	...	8·7
Feb.	20	...	9·0
March	14	...	9·5

SOLAR ECLIPSES OF THE 20TH CENTURY.—In a reprint from the *Bulletin de la Société Astronomique de France* for November, M. Camille Flammarion brings together the local particulars for the eclipses of the sun which will be visible in Paris during the 20th century. Forty-three eclipses will be visible, but only thirty-three under good observing conditions. Special attention is drawn to the eclipses of April 17, 1912, and August 11, 1999, as although Paris is not included in the path of totality, in each case the central line of eclipse is only a short distance away from the capital. Maps are given of the paths of the shadow for both dates. These are also reproduced in the last number of the *Bulletin* (March).

A BRILLIANT FIREBALL.—On March 28, 8h. 31m., a very large meteor, giving several flashes like vivid lightning, was observed from the south-eastern parts of England. At Bishops Stortford, Herts, the light was so great that it illuminated the country, and three distinct explosions were observed. A sound like that of the roar of a distant cannon followed the disappearance of the meteor, and would indicate that it was 24 miles distant, but this is probably much underestimated. The meteor descended from the constellation Leo in the south. In Berkshire it was seen falling in Virgo, and it flashed out very brilliantly just prior to its disruption. The head of the meteor was very much brighter than Venus, and it travelled rather swiftly. Two vivid flashes were observed here as at Reading, where the terminal point of the flight was noted as being near ϵ Virginis. At the latter place the phenomenon ended in a cloud of sparks, and for a moment the sky and landscape were flooded in light. At Blackheath the meteor was seen by Mr. Crommelin, of the Greenwich Observatory. He estimated it as three times as brilliant as Venus at her brightest, and describes the terminal point as 1° N. of β Leonis. Many reports of this brilliant object are available for discussion, and it will be possible to determine its real path satisfactorily. Many large fireballs are directed in very slow flights from westerly radiants, but in this case the object moved swiftly, and probably had a radiant not far from the star ϵ in Ursa Major. Its position was over the east coast of Kent, and its height, when it finally burst and disappeared, about 52 miles.

MODERN EXPLOSIVES.[1]

THE subject of explosives is one which never fails to excite interest even under the most ordinary conditions, doubtless owing to the enormous potentiality of these substances, whilst at the present time more than usual attention is directed to them, it being scarcely possible to read a daily paper without finding some reference to the behaviour of various modern explosives in the theatre of war.

Explosion may be defined as chemical action causing extremely rapid formation of a very great volume of highly expanded gas, this large volume of gas being generally due to the direct liberation by chemical action and the further enormous expansion by the heat generated. Explosion itself may therefore be regarded as extremely rapid combustion, whilst the effect is obtained by the enormous pressure produced owing to the products of combustion occupying probably many thousand times the volume of the original body. The effect of high temperature is seen in the well-known case of explosion of a mixture of hydrogen and oxygen, where if the original mixture and the products of explosion are each measured at the same temperature above the boiling point of water, a less volume of gas (water vapour) is actually found. The explosion can only have been produced by the enormous expansion of this vapour in the first place by the heat of the reaction. Such an explosion when carried out in a closed bomb with the mixed gases under ordinary conditions of measurement produces a pressure of about 240 lbs. to the square inch. A more practical illustration is seen with nitroglycerine, which Nobel found yielded about 1200 times its own volume of gas calculated at ordinary temperatures and pressures, whilst the heat liberated expands the gas to nearly eight times this volume.

Clearly, then, a substance for use as an explosive must be capable of undergoing rapid decomposition or combination with the production of large volumes of gas, and further produce sufficient heat to greatly expand these gases; the ratio of the volume of gases at the moment of explosion to the volume of the original body largely determining the efficiency of the explosive.

Explosives may be divided into two great classes—mechanical mixtures and chemical compounds. In the former the combustible substances are intimately mixed with some oxygen-supplying material, as in the case of gunpowder, where carbon and sulphur are intimately mixed with potassium nitrate; while gun-cotton and nitroglycerine are examples of the latter class, where each molecule of the substance contains the necessary oxygen for the oxidation of the carbon and hydrogen present, the oxygen being in feeble combination with nitrogen. Many explosives are, however, mechanical mixtures of compounds which are themselves explosive, *e.g.* cordite, which is mainly composed of gun-cotton and nitroglycerine.

Two methods are in common use for bringing about explosions—ignition by heat, thus bringing about ordinary but rapid combustion, molecule after molecule undergoing decomposition; and detonation, where the effect is infinitely more rapid than in the first case; in fact, it may be regarded as practically instantaneous. The result may be looked upon as brought about by an initial shock imparted to the explosive by a substance—the detonating material—which is capable of starting decomposition in the adjacent layers of the explosive, thus causing a shock to the next layer and so on with infinite rapidity. That the results are not entirely due to the mechanical energy of the liberated gas particles is shown by the fact that the most powerful explosive is not the most powerful detonator; neither is it entirely due to heat, since wet substances undergo detonation. The probability is that the result is brought about by vibrations of particular velocity which vary for different substances, the decomposition being caused by the conversion of the mechanical force into heat in the explosive, thus bringing about a change in the atomic arrangement of the molecule. According to Sir Frederick Abel's theory of detonation, the vibrations caused by the firing of the detonator are capable of setting up similar vibrations in the explosive, thus determining its almost instantaneous decomposition.

The most common and familiar of explosives is undoubtedly gunpowder, and although for military purposes it has been largely superseded by smokeless powders, yet it has played such an important part in the history of the world during the last few centuries that apart from military uses it is even now of sufficient importance to demand more than a passing notice.

Its origin, although somewhat obscure, was in all probability with the Chinese. Roger Bacon and Berthold Schwartz appear to have rediscovered it in the latter years of the thirteenth and earlier part of the fourteenth centuries. It was undoubtedly used at the battle of Crecy. The mixture then adopted appears to have consisted of equal parts of the three ingredients—sulphur, charcoal and nitre; but some time later the proportions, even now taken for all ordinary purposes, were introduced, namely—

Potassium nitrate...	75 parts
Charcoal	15 ,,
Sulphur	10 ,,
	100 ,,

Since gunpowder is a mechanical mixture, it is clear that the first aim of the maker must be to obtain perfect incorporation, and necessarily in order to obtain this, the materials must be in a very finely divided state. Moreover, in order that uniformity of effect may be obtained, purity of the original substances, the percentage of moisture present, and the density of the finished powder are of importance.

The weighed quantities of the ingredients are first mixed in gun-metal or copper drums, having blades in the interior capable of working in the opposite direction to that in which the drum itself is travelling. After passing through a sieve, the mixture (green charge) is passed on to the incorporating mills, where it is thoroughly ground under heavy metal rollers, a small quantity of water being added to prevent dust and facilitating incorporation, and during this process the risk of explosion is greater possibly

[1] A lecture delivered at the London Institution on February 12, by Mr. J. S. S. Brame.